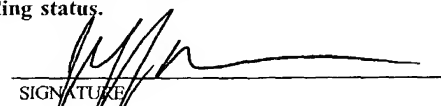


FORM PTO-1390 (REV. 9-2001)		U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTORNEY'S DOCKET NUMBER 627-1446
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371			U.S. APPLICATION NO. (If known, see 37 CFR 1.5) 10/009302
INTERNATIONAL APPLICATION NO. PCT/SE00/01049	INTERNATIONAL FILING DATE 24 May 2000	PRIORITY DATE-CLAIMED 15 June 1999	
TITLE OF INVENTION METHOD AND DEVICE FOR BATTERIES			
APPLICANT(S) FOR DO/EO/US LINDQVIST, Frank LINDQVIST, Henrik			
Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:			
<p>1. <input checked="" type="checkbox"/> This is a FIRST submission of items concerning a filing under 35 U.S.C. 371.</p> <p>2. <input type="checkbox"/> This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371.</p> <p>3. <input type="checkbox"/> This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below.</p> <p>4. <input checked="" type="checkbox"/> The US has been elected by the expiration of 19 months from the priority date (Article 31).</p> <p>5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371(c)(2))</p> <p style="margin-left: 20px;">a. <input checked="" type="checkbox"/> is attached hereto (required only if not communicated by the International Bureau).</p> <p style="margin-left: 20px;">b. <input checked="" type="checkbox"/> has been communicated by the International Bureau.</p> <p style="margin-left: 20px;">c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US).</p> <p>6. <input type="checkbox"/> An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).</p> <p style="margin-left: 20px;">a. <input type="checkbox"/> is attached hereto.</p> <p style="margin-left: 20px;">b. <input type="checkbox"/> has been previously submitted under 35 U.S.C. 154(d)(4).</p> <p>7. <input checked="" type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))</p> <p style="margin-left: 20px;">a. <input checked="" type="checkbox"/> are attached hereto (required only if not communicated by the International Bureau).</p> <p style="margin-left: 20px;">b. <input checked="" type="checkbox"/> have been communicated by the International Bureau.</p> <p style="margin-left: 20px;">c. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired.</p> <p style="margin-left: 20px;">d. <input type="checkbox"/> have not been made and will not be made.</p> <p>8. <input type="checkbox"/> An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).</p> <p>9. <input type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).</p> <p>10. <input type="checkbox"/> An English language translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).</p> <p>Items 11 to 20 below concern document(s) or information included:</p> <p>11. <input checked="" type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98. International Search Report</p> <p>12. <input type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.</p> <p>13. <input checked="" type="checkbox"/> A FIRST preliminary amendment. To Be Entered Prior To Claims Fee Calculation.</p> <p>14. <input type="checkbox"/> A SECOND or SUBSEQUENT preliminary amendment.</p> <p>15. <input type="checkbox"/> A substitute specification.</p> <p>16. <input type="checkbox"/> A change of power of attorney and/or address letter.</p> <p>17. <input type="checkbox"/> A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.</p> <p>18. <input type="checkbox"/> A second copy of the published international application under 35 U.S.C. 154(d)(4).</p> <p>19. <input type="checkbox"/> A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).</p> <p>20. <input checked="" type="checkbox"/> Other items or information: International Preliminary Examination Report</p>			

U.S. APPLICATION NO (if known, see 37 CFR 1.5) 10/009302		INTERNATIONAL APPLICATION NO PCT/SE00/01049		ATTORNEY'S DOCKET NUMBER 627-1446	
21. <input checked="" type="checkbox"/> The following fees are submitted: BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)): Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO \$1040.00 International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO \$890.00 International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO \$740.00 International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4) \$710.00 International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) \$100.00 ENTER APPROPRIATE BASIC FEE AMOUNT =				CALCULATIONS PTO USE ONLY	
Surcharge of \$130.00 for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input checked="" type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(e)).				\$ 890	
				\$ 130	
CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	\$	
Total claims	42 - 20 =	22	x \$18.00	\$ 396	
Independent claims	2 - 3 =	0	x \$84.00	\$	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)				+ \$280.00	\$
TOTAL OF ABOVE CALCULATIONS =				\$ 1416	
<input checked="" type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by 1/2.				\$ 708	
SUBTOTAL =				\$ 708	
Processing fee of \$130.00 for furnishing the English translation later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(f)).				\$	
TOTAL NATIONAL FEE =				\$	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property +				\$	
TOTAL FEES ENCLOSED =				\$ 708	
				Amount to be refunded:	\$
				charged:	\$
a. <input checked="" type="checkbox"/> A check in the amount of \$ <u>708</u> to cover the above fees is enclosed. b. Please charge my Deposit Account No. _____ in the amount of \$ _____ to cover the above fees. A duplicate copy of this sheet is enclosed. c. <input checked="" type="checkbox"/> The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. <u>50-0687</u> . A duplicate copy of this sheet is enclosed Order No. 62627 d. <input type="checkbox"/> Fees are to be charged to a credit card. WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.					
NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137 (a) or (b)) must be filed and granted to restore the application to pending status.					
SEND ALL CORRESPONDENCE TO: <div style="display: flex; justify-content: space-between;"> <div>Customer No. 20736</div> <div style="text-align: right;">  SIGNATURE Jeffrey S. Melcher NAME <u>35,950</u> REGISTRATION NUMBER </div> </div>					

JC13 Rec'd PCT/PTO 07 DEC 2001

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re PATENT Application of
Lindqvist, et. al.

Group Art Unit: Unknown

U.S. National Phase of
PCT/SE00/01049

Examiner: Unknown

Filed: December 7, 2001

Att. Docket No.: 627-1446

For: METHOD AND DEVICE FOR BATTERIES

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December 7, 2001

PRELIMINARY AMENDMENT TO BE ENTERED BEFORE CALCULATION OF
CLAIMS FEES AND CONSIDERED PART OF THE ORIGINAL FILING AND
EXPLANATION OF AMENDMENT

Hon. Asst. Commissioner of Patents
and Trademarks
Washington, D.C. 20231

Sir:

Please preliminarily amend the subject application as follows:

IN THE CLAIMS:

Please amend claims 1-13 as follows:

1. (Amended) Method for treatment of accumulators having at least one cell comprising the steps of applying a varying direct current from a charging unit to at least one cell in an accumulator in intermittent current supply periods, which are interrupted by current free pauses, the direct current being sufficient to generate gas in the accumulator, wherein said treatment comprises a regeneration process, wherein said current supply periods have a length of between 0.01 and 0.5 seconds, a current level during said current supply periods amounting to between 80 and 1000 A, said pauses having a length of 1 to 20 seconds; registering process data for at least one cell in the accumulator during the treatment process; and controlling the treatment process with said process data.
2. (Amended) Method according to claim 1, wherein a conductivity in an electrolyte in the cell, and/or a temperature in the electrolyte in the cell [constitutes] comprises said process data.
3. (Amended) Method according to claim 1, wherein sensors for said process data are introduced down into the electrolyte in each cell where process data is to be registered.
4. (Amended) Method according to claim 1, wherein what is controlled during the treatment process is a length of said current supply periods, which may

be between 0.01 and 0.5 seconds, a length of said pauses, which may be between 1-20 seconds, and the current supply periods preferably being considerably shorter than the pauses.

5. (Amended) Method according to claim 1, wherein a current is applied during the current supply periods, which current is strong enough in order for each cell in the accumulator to reach a voltage of at least 2.5 V during the current supply periods.
6. (Amended) Method according to claim 1, wherein said current level during said current supply periods amounts to at least 110 A and 1000 A at the most.
7. (Amended) Method according to claim 1, wherein a current level during said current supply periods is 150 A at the most.
8. (Amended) Method according to claim 1, wherein the treatment process is performed in a number of cycles, each cycle comprising a regeneration part of 2-8 hours, and a charge part.
9. (Amended) Method according to claim 1, wherein said registering of process data and said controlling, is continuously performed during the entire or substantially the entire treatment process.
10. (Amended) Method according to claim 1, wherein said registering of process data is performed during a predetermined time period of the entire treatment period.
11. (Amended) Method according to claim 1, wherein said registering of process data and controlling based on this process data, is individually performed for all or substantially all cells in the accumulator.
12. (Amended) Method according to claim 1, wherein the total current running to the accumulator during the current supply periods is registered by surveying of a mean value for said process data for a small number of current supply periods, optimal control, and thereby optimal treatment, thereafter being ensured when the mean value of the succeeding current supply periods, remains in the main constant.
13. (Amended) Method according to claim 1, wherein general data, for each individual accumulator, is used for the controlling of the treatment process, which general data is chosen from the group consisting of name of the customer, date, accumulator manufacturer, type number for the accumulator, type values for the accumulator, year of manufacture, time of the first operational use of the accumulator, time between previously performed treatments, and type of device in which the accumulator is used.
14. (Amended) Method according to claim 13, wherein older general data and process data too, for other accumulators and/or for previous treatments of the

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specific accumulator, are used for the controlling of the treatment process.

15. (Amended) Method according to claim 14, wherein access to said older general data and older process data is ensured by connection to a network having a common database for these data for different devices for the treatment of accumulators.
16. (Amended) Method according to claim 15, wherein said network also is arranged to be used for the surveillance of the treatment process and/or for the upgrading of software for the treatment process.
17. (Amended) Device for treatment of accumulators having at least one cell, which device comprises a transformer having a primary coil adapted to be connected to the electricity supply network, a secondary coil, a rectifier connected to the secondary coil, a positive cable clip and a negative cable clip, adapted to be connected to an accumulator which is to be treated, and an automatic actuator connected to the primary coil for intermittent connecting and disconnecting of the electricity supply network with short current supply periods interrupted by current free pauses, wherein said device comprises a device for a regeneration process, the device being arranged to conduct said current supply periods with a length of between 0.01 and 0.5 seconds, a current level during said current supply periods being arranged to amount to between 80 and 1000 A, and to conduct said pauses with a length of 1-20 seconds, and in that the device also comprises means for registering and measuring of process data of at least in one cell of the accumulator, and means for controlling the treatment process based on this process data.
18. (Amended) Device according to claim 17, wherein sensors for registering and measuring a conductivity in an electrolyte in the cell, comprises said means for registering and measuring process data, and/or sensors for registering and measuring a temperature in the electrolyte in the cell.
19. (Amended) Device according to claim 17, wherein said means for registering and measuring process data are arranged to individually register and measure process data in all or substantially all cells of the accumulator.
20. (Amended) Device according to claim 17, wherein said means for controlling the treatment process comprises a control unit and means for dynamically, during the treatment process, altering the length of said current supply periods to between 0.01 and 0.5 seconds, a length of said pauses, which may be between 1-20 seconds, and the current supply periods preferably being considerably shorter than the pauses.
21. (Amended) Device according to claim 17, wherein the device is arranged to yield a current during said current supply periods, which current is strong enough in order for each cell in the accumulator to be brought to reach a voltage of at least 2.5 V during the current supply periods.

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22. (Amended) Device according to claim 17, wherein the current level during said current supply periods is at least 110 A.
23. (Amended) Device according to claim 17, wherein the current level during said current supply periods is 150 A at the most.
24. (Amended) Device according to claim 17, wherein said means for the registering and measuring data is chosen from the group consisting of name of the customer, date, accumulator manufacturer, type number for the accumulator, type values for the accumulator, year of manufacture, time of the first operational use of the accumulator, time between previously performed treatments, and type of device in which the accumulator is used.
25. (Amended) Device according to claim 24, wherein said device comprises means for connecting it to a database via a network for use of older general data and process data for previous treatment processes, for other accumulators and/or for previous treatments of the specific accumulator, in the controlling of the treatment process.
26. (Amended) Device according to claim 25, wherein said network also is arranged to be used for the surveillance of the treatment process and/or for the upgrading of software for the treatment process.

Please add new claims 27- 42 as follows:

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27. Method according to claim 1, wherein said battery is a lead acid battery.
28. Method according to claim 4, wherein the length of said current supply periods is from 0.1- 0.5 seconds and the length of said pauses is from 1-10 seconds.
29. Method according to claim 4, wherein the length of said current supply periods is from 0.15 to 0.5 seconds and the length of said pauses is from 1-5 seconds.
30. Method according to claim 4, wherein the length of said current supply periods is from 0.1 to 0.4 seconds and the length of said pauses is 1-5 seconds.
31. Method according to claim 6, wherein said current level during said current supply periods amounts to at least 200 A and 1000 A at the most.
32. Method according to claim 6, wherein said current level during said current supply periods amounts to at least 250 A and 1000 A at the most.
33. Method according to claim 7, wherein a current level during said current supply periods is 110 A at the most.

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34. Method according to claim 8, wherein the treatment process is performed in 5 to 30 cycles, each cycle comprising a regeneration part of 2 to 6 hours and a charge part using a continuous current supply.
35. Method according to claim 34, wherein the charge part is conducted from 0.5 to 2 hours
36. Method according to claim 34, wherein the charge part is conducted for about 1 hour.
37. Method according to claim 34, wherein the treatment process is performed in 5 to 20 cycles.
38. Method according to claim 10, wherein said registering of process data is performed during start up of the treatment.
39. Method according to claim 13, wherein the general data is registered automatically at start up of the treatment process.
40. Device according to claim 18, wherein said registering and measuring is arranged to be performed by opening of the accumulator and applying said sensors.
41. Device according to claim 20, wherein said means for controlling the treatment process comprises a microcomputer.
42. Device according to claim 24, further comprising a means for registering and measuring data for each individual accumulator.

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EXPLANATION OF AMENDMENT:

Claims 1-26 have been amended as shown by [deletions] and insertions.

1. (Amended) Method for treatment of accumulators having at least one cell[, preferably lead batteries, in which] comprising the steps of applying a varying direct current from a charging unit [is applied] to at least one cell in an accumulator in intermittent current supply periods, which are interrupted by current free pauses, the direct current being sufficient to generate gas in the accumulator, [characterised in that] wherein said treatment [constitutes] comprises a regeneration process, wherein said current supply periods have a length of between 0.01 and 0.5 seconds, a current level during said current supply periods amounting to between 80 and 1000 A, said pauses have a length of 1-20 seconds[, and wherein]; registering process data[,] for at least one cell in the accumulator[, is registered] during the treatment process[, which]; and controlling the treatment process with said process data [is used

predetermined time period of the entire treatment period[, preferably during start up of the treatment].

11. (Amended) Method according to [any of the preceding claims, characterised in that] claim 1, wherein said registering of process data and controlling based on this process data, is individually performed for all or [essentially] substantially all cells in the accumulator.
12. (Amended) Method according to [any of the preceding claims, characterised in that] claim 1, wherein the total current running to the accumulator during the current supply periods is registered[, preferably] by surveying of a mean value for said process data for a small number of current supply periods, optimal control, and thereby optimal treatment, thereafter being ensured when the mean value of the succeeding current supply periods, remains in the main constant.
13. (Amended) Method according to [any of the preceding claims, characterised in that] claim 1, wherein general data, for each individual accumulator, is used for the controlling of the treatment process, which general data [preferably] is chosen from the group consisting of name of the customer, date, accumulator manufacturer, type number for the accumulator, type values for the accumulator, year of manufacture, time of the first operational use of the accumulator, time between previously performed treatments, and type of device in which the accumulator is used[, and which general data preferably is registered automatically at start up of the treatment process].
14. (Amended) Method according to claim 13, [characterised in that] wherein older general data and process data too, for other accumulators and/or for previous treatments of the specific accumulator, are used for the controlling of the treatment process.
15. (Amended) Method according to claim 14, [characterised in that] wherein access to said older general data and older process data is ensured by connection to a network having a common database for these data for different devices for the treatment of accumulators.
16. (Amended) Method according to claim 15, [characterised in that] wherein said network also is arranged to be used for the surveillance of the treatment process and/or for the upgrading of software for the treatment process.
17. (Amended) Device for treatment of accumulators having at least one cell, [preferably lead batteries,] which device comprises a transformer having a primary coil adapted to be connected to the electricity supply network, a secondary coil, a rectifier connected to the secondary coil, a positive cable clip and a negative cable clip, adapted to be connected to an accumulator which is to be treated, and an automatic actuator connected to the primary coil for intermittent connecting and disconnecting of the electricity supply network with short current supply periods interrupted by current free pauses,

- [characterised in that] wherein said device [constitutes] comprises a device for a regeneration process, the device being arranged to conduct said current supply periods with a length of between 0.01 and 0.5 seconds, a current level during said current supply periods being arranged to amount to between 80 and 1000 A, and to conduct said pauses with a length of 1-20 seconds, and in that the device also comprises means for [registering/measuring] registering and measuring of process data[, of at least in one cell of the accumulator, and means for controlling the treatment process based on this process data.
18. (Amended) Device according to claim 17, [characterised in that] wherein sensors for registering[/] and measuring a conductivity in an electrolyte in the cell, [constitutes] comprises said means for registering [/] and measuring process data, and/or sensors for registering [/] and measuring a temperature in the electrolyte in the cell[, said registering/measuring preferably being arranged to be performed by opening of the accumulator and applying said sensors].
 19. (Amended) Device according to [any of claims 17-18, characterised in that] claim 17, wherein said means for registering [/] and measuring process data are arranged to individually register[/] and measure process data in all or [essentially] substantially all cells of the accumulator[, the treatment process preferably being arranged to be individually controlled in these cells, based on the process data for each cell].
 20. (Amended) Device according to [any of claims 17-19, characterised in that] claim 17, wherein said means for controlling the treatment process comprises a control unit[, preferably a microcomputer,] and means for dynamically, during the treatment process, altering the length of said current supply periods to between 0.01 and 0.5 seconds[, preferably at least 0.1 seconds, even more preferred at least 0.15 seconds and 0.4 seconds at the most, preferably 0.25 seconds at the most], a length of said pauses, which may be between 1-20 seconds, [preferably 1-10 seconds and even more preferred 1-5 seconds, typically about 3 seconds,] and the current supply periods preferably being considerably shorter than the pauses[, and optionally, the current level used].
 21. (Amended) Device according to [any of claims 17-20, characterised in that] claim 17, wherein the device is arranged to yield a current during said current supply periods, which current is strong enough in order for each cell in the accumulator to be brought to reach a voltage of at least 2.5 V during the current supply periods.
 22. (Amended) Device according to [any of claims 17-21, characterised in that] claim 17, wherein the current level during said current supply periods is at least 110 A[, preferably at least 200 A and even more preferred at least 250 A, but 1000 A at the most].
 23. (Amended) Device according to [any of claims 17-21, characterised in that] claim 17, wherein the current level during said current supply periods is 150 A

at the most[, preferably 110 A at the most].

24. (Amended) Device according to [any of claims 17-23, characterised in] claim 17, wherein said means for the[, preferably automatic, registering/feeding in of general] registering and measuring data[, for each individual accumulator, which general data preferably] is chosen from the group consisting of name of the customer, date, accumulator manufacturer, type number for the accumulator, type values for the accumulator, year of manufacture, time of the first operational use of the accumulator, time between previously performed treatments, and type of device in which the accumulator is used.
25. (Amended) Device according to claim 24, [characterised in that] wherein said device comprises means for connecting it to a database[, preferably] via a network[,] for use of older general data and process data for previous treatment processes, for other accumulators and/or for previous treatments of the specific accumulator, in the controlling of the treatment process.
26. (Amended) Device according to claim 25, [characterised in that] wherein said network also is arranged to be used for the surveillance of the treatment process and/or for the upgrading of software for the treatment process.

REMARKS

Consideration and allowance of the subject application are respectfully requested.

Claims 1-42 are pending in the application.

Claims 1-26 have been amended merely to remove multiple dependencies and correct minor informalities. No claims have been amended to overcome prior art. No new matter has been added.

Basis for new claims 27-42 can be found in the present specification including as follows:

- claim 27 at original claim 1;
- claims 28-30 at original claim 4;
- claims 31 and 32 at original claim 6;
- claim 33 at original claim 7;
- claims 34-37 at original claim 8;
- claim 38 at original claim 10;

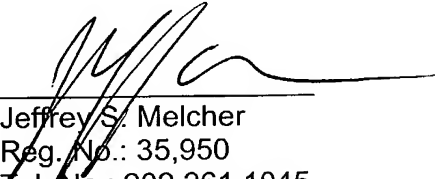
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claim 39 at original claim 13;
claim 40 at original claim 18;
claim 41 at original claim 20; and
claim 42 at original claim 24.

Early and favorable action on the merits are respectfully requested.

Respectfully submitted,
Manelli Denison & Selter, PLLC

By



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METHOD AND DEVICE FOR BATTERIES

TECHNICAL FIELD

The present invention relates to a method and device for treatment, in the form of re-
5 generation, of accumulators having at least one cell, preferably lead batteries, in which a
varying direct voltage from a charging unit, is applied in intermittent current supply
periods which are interrupted by current free pauses, the direct voltage being sufficient
to generate gas in the accumulator.

10 THE TECHNICAL STANDPOINT

In a charged lead accumulator, i.e. a lead battery, the active substance in the positive
electrodes consists of lead superoxide, PbO_2 , and of porous metallic lead in the negative
electrodes. When the battery is discharged, these active substances are converted to lead
sulphate, $PbSO_4$, sulphate ions being taken from the electrolyte, which is sulphuric acid.
15 In principle the process is the reversed at charging. Conventionally, when being re-
charged by a continuous direct current, lead accumulators have, however, a limited abil-
ity of being recharged. The reason for this is not completely investigated, but it is sup-
posed that influence is made by factors such as the products of discharge having a lim-
ited solubility in the electrolyte, it being considered that diffusion of the divalent lead
20 ions constitutes the limiting factor both at discharging and recharging. Furthermore,
lead sulphate is a very poor conductor of electricity. All these circumstances often result
in problems in connection with the charging of lead batteries, which i.a. risks being de-
stroyed by inactive layers of lead sulphate which hinders the charging or decreases the
capacity, and which eventually makes the battery useless. In addition, there are prob-
25 lems in the form of different densities before and after the charging, which leads to the
formation of sludge and to a decreased strength.

In WO 94/28610, there is presented a solution to the above problems in connection with
the charging of accumulators, especially lead batteries. According to this document,
30 lead batteries may thus be charged by high current levels with a very good result and
without a noticeable increase in temperature, when a direct voltage is being applied on
the battery in intermittent current supply periods, interrupted by pauses in which no cur-
rent is supplied, which periods are between about 0.5 seconds and about 10 seconds.
The battery may be charged from a discharged state, in which case the current supply
35 intervals and the pause intervals are of approximately the same length, preferably be-
tween 0.5 and 1.5 seconds, one example presenting a current strength of 90 A being
used, but it may also be maintenance charged by current supply periods of 0.5 seconds

at the most, the intervals there between being longer, e.g. 10 seconds or more, at lower current levels. The process is especially directed towards a fast process for charging.

One problem with the technique which is described in WO 94/28610 is that the method
5 not is adapted to every single battery which is to be recharged. Neither is it possible to control the charging process, other than by setting base parameters for every charging that is done, in which setting there is made a choice as to whether the process is to constitute a charging of a discharged battery, or a maintenance charging of a non discharged battery. Neither is the method adjustable in consideration to experiences from
10 chargings which have been previously performed, not is it directed upon regeneration.

In US 1,743,594 there is described another, older method of charging batteries in the shortest possible time, which accordingly does not aim at performing a regeneration of the battery. Thereby, the charging takes place by pulses of up to 100 A current strength
15 during periods of 1.5-2 seconds, with pauses of the same length them between.

In US 3,963,976 there is described yet another method for charging batteries, which is not adapted to performing a regeneration of the same. The object of the method is to achieve a mixing through of the electrolyte by the circulation which takes place in connection with the formation of gas. In the document, it is stated that current strengths of
20 up to 1500 A may be used, but at the same time it is warned that pulse periods of greater length may be harmful. It is in this connection stated that the pulse period may be 0.5-50 milliseconds, whereby the peak of the current strength only lasts about one millisecond. Furthermore, it is stated that the pulses should be generated at the same time as a constant charging takes place, it being recommended that the pulse treatment takes place at
25 the end of the charging, i.e. when the battery is almost fully charged.

In WO 96/17426 there is described a system for charging of lead batteries, in which weak current pulses are used, mixed with extremely short current supply pulses, "current spikes", of relatively low current strengths. When the cell voltage reaches a level
30 when generation of gas commences, the charging shifts to a constant voltage charging until the battery is fully charged. The controlling of the device makes use of a micro processor and is based upon measurements of the cell voltage and the internal resistance.

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One problem which is not solved by any of the just mentioned methods is how to perform a regeneration of worn batteries in a way that can be optimised and controlled for

each given battery. Instead, the mentioned methods aims at achieving a fast and optimised charging or maintenance charging of more conventional type.

DESCRIPTION OF THE INVENTION

5 One object of the present invention is accordingly to offer a method for treatment, in the form of regeneration, of accumulators, the treatment process being controlled, in terms of current supply period, pauses and current strength, based on given input data. As input data, there is thereby used process data which are registered cell by cell during the treatment process, preferably at least the temperature and the conductivity of the electrolyte in the accumulator. Additional input data for the controlling of the treatment process are general data for the accumulator/battery, which general data are being fed in at the start of the treatment process. The controlling of the treatment process is preferably performed automatically, by hardware and software which is adapted for the process, preferably by use of a microcomputer or the like. For the controlling there may also be used process data from earlier treatment processes, such earlier process data constituting experience data which is used in order to optimise the treatment process taking place.

20 A basic object of the method and device according to the invention, is to achieve a regeneration of batteries which is non destructive to the battery. The treatment process should moreover be adaptable and controllable for every single battery.

Accordingly, there is according to the invention introduced a method for treatment of accumulators according to claim 1.

25 By the ability to absorb current/the conductivity being determined for at least one cell in the battery during the treatment process, the treatment process can be controlled by aid of a control unit, preferably e.g. a microcomputer, based on measured process data, preferably at least in the form of measured temperature and conductivity. The measuring of process data and the controlling based on these process data may be performed individually for all or essentially all cells in the accumulator. An alternative, preferred form of surveillance is to measure the total current which runs to the accumulator during the current supply period. This is done by surveillance of the mean value of temperature and conductivity, during a number of current supply periods, e.g. ten periods. When the mean value of the subsequent current supply periods remains in the main constant, e.g. within a limit of typically about 5%, for a longer period, e.g. about 1000 current supply

periods, this means that maximum/optimum regeneration is achieved with the parameters as set.

At the treatment process, a direct voltage is applied, usually a half-wave rectified alternating voltage from a common charging unit, in intermittent current supply periods, interrupted by current free pauses, which current supply periods have a duration of between 0.01 and 10 seconds, preferably between 0.01 and 0.4 seconds, and even more preferred between 0.1 and 0.5 seconds. Most preferred, a lowermost limit for the length of the current supply periods is 0.1 seconds, preferably 0.15 seconds, and an uppermost limit is 0.5 seconds, preferably 0.4 seconds and even more preferred 0.25 seconds. It has been shown in experimental tests that a very advantageous current supply period is 0.18 seconds. At the treatment, it is suitable to make the time periods for current supply and pause of unequal length, whereby the pauses are longer than the current supply periods, the pauses typically having a length of 1-20 seconds, preferably 1-10 seconds and even more preferred 1-5 seconds, typically about 3 seconds, it however being possible to vary them individually by controlling the process according to the present invention. The shortest pauses within the ranges are used in connection with the shortest current supply within the ranges, and vice versa. Thanks to the pauses being considerably longer than the current supply periods, there is also attained the advantage that the accumulator doesn't get too warm during the treatment. The current strength used in the current supply periods is 80-300 A or even more preferred up to 1000 A, at least in the case of so called traction batteries, the highest values being related to the accumulator being in a relatively good shape, and the lowest values to the same being in a bad shape. Most preferred, current strengths of at least 110 A, preferably at least 200 A and even more preferred at least 250 A, are used for these kind of traction batteries. For smaller batteries, e.g. batteries for passenger cars, there is on the contrary used lower current strengths, normally below 150 A, preferably below 110 A, but not lower than 80 A.

When the regeneration process according to the invention is commenced, the accumulator should not be entirely discharged but not fully charged either. Instead, it should suitably be partially charged, e.g. about half-way charged. Maintenance charging should be performed by constant, i.e. continuous charging.

At the treatment process according to the invention, contaminants in the form of sulphate crystals on the electrodes, which contaminants have been built up during discharge, are removed. By the very short current periods, of only some tenths of a second, with a high current, which are mixed with pauses of considerably greater length, there is

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35 According to yet another aspect of the invention, the general data for the battery, which are used as input data for controlling of the treatment process, are constituted by any,

some or all input data in the group consisting of name of the customer, date, battery manufacturer, type number for the battery, type values for the battery, year of manufacture, time of the first operational use of the battery, time between each previously performed treatment, type of vehicle in which the battery is used and data registered in previous treatments, e.g. cell voltage and electrolyte density. These general data, or at least
5 a main part of them, may be stored in a data storing unit attached to the battery, e.g. a chips, a bar code, or in a data bank in the device for the treatment, or similar.

According to yet another aspect of the invention, the treatment of a certain battery is
10 performed when the conductivity which is determined at a certain cell voltage for this specific battery has reached a predetermined critical value.

According to another aspect of the invention, several devices for treatment of accumulators may share the same old process data from previous treatment sessions, by being
15 connected to each other in a network. Hereby, a single server, in the network, may contain a database which is common for the devices, having experience values from previous treatment processes. Thus, there may be used experiences/process data from previous treatments of batteries of the same or similar type in other treatment devices which also are connected to the network, for controlling the treatment of a certain battery in a
20 first treatment device, which is connected to the network. The control units of the batteries may be connected to the network by GSM and/or local radio/telemetric communication systems, such as dect, blue tooth etc., or corresponding systems. By the network and the common server, it is also possible to remotely survey the devices and to upgrade the software of their control units.

25 Since every accumulator behaves individually, which strongly depends on its history, i.e. the treatment and environmental influence which it has been exposed to, the optimal treatment method for different accumulators varies. By putting together a database, according to the above, which contains essential parameters for each treated accumulator, before, during and after previously performed regenerations in combination with the
30 type of the accumulator, there may be put together an algorithm (e.g. in the form of an equation or matrix), in order to achieve the best possible treatment process for each new treatment of an accumulator. From a commercial point of view, it may thereby be of extra importance to be able to predict the expected treatment time. Such a database may
35 be built by combining the data which has been collected from the greatest possible number of regenerating machines. This may be done by these data being manually combined and distributed, which however is practically difficult why the best solution is to

connect the machines in a network, permanently or temporarily. Thereby, there may be used a classic Server-Client network (LAN), or the Internet, in order to in a simple way achieve a global network.

5 DESCRIPTION OF THE FIGURE

In the following, a device according to the invention, for the performance of the method according to the invention, will be described, while referring to Fig. 1, which is a block diagram.

- 10 The auto monitor control is achieved by a control unit 110, for example a suitably programmed microprocessor and its surrounding circuits, which controls a switch means, such as a contactor 120. This is breaking and closing a feed path for electrical energy, which is supplied by a voltage source 130, e.g. the common electricity supply network. The voltage is transformed into a desired value by means of a transformer 140, where
15 after it is supplied to a rectifier 150. Thereafter, the rectified voltage is supplied to the battery 160, as a treatment voltage.

- A limitation circuit 170 acts as an auto monitor control of current and temperature. If the feed current or the battery temperature, which are surveyed by the temperature and
20 conductivity surveillance 200, becomes too high, the rectifier 150, and thereby the feed to the battery 160, is deactivated.

- The control unit 110 controls the contactor 120 based on registered process data, which process data are registered by means of the temperature and conductivity surveillance
25 200 and a voltage surveillance circuit 180. The control unit 110 also makes use of general data for the specific battery, for the control, as well as older process data and general data, which are available to the control unit via a network connection. Moreover, the control unit 110 controls a discharge circuit 190, by which the battery can be discharged at a predetermined current.

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The invention is not limited by the above described embodiments, but may be varied within the scope of the claims. The device and method according to the invention is e.g. also suitable for other types of accumulators than lead batteries, e.g. nickel-cadmium and nickel-iron accumulators.

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CLAIMS

1. Method for treatment of accumulators having at least one cell, preferably lead batteries, in which a varying direct current from a charging unit is applied in intermittent current supply periods, which are interrupted by current free pauses, the direct current being sufficient to generate gas in the accumulator, characterised in that said treatment constitutes a regeneration process, wherein said current supply periods have a length of between 0.01 and 0.5 seconds, a current level during said current supply periods amounting to between 80 and 1000 A, said pauses have a length of 1-20 seconds, and wherein process data, for at least one cell in the accumulator, is registered during the treatment process, which process data is used in order to control the treatment process.
2. Method according to claim 1, characterised in that a conductivity in an electrolyte in the cell, and/or a temperature in the electrolyte in the cell constitutes said process data.
3. Method according to claim 1 or 2, characterised in that sensors for said process data are introduced down into the electrolyte in each cell where process data is to be registered.
4. Method according to any of the preceding claims, characterised in that what is controlled during the treatment process is a length of said current supply periods, which may be between 0.01 and 0.5 seconds, preferably at least 0.1 seconds, even more preferred at least 0.15 seconds and 0.4 seconds at the most, preferably 0.25 seconds at the most, a length of said pauses, which may be between 1-20 seconds, preferably 1-10 seconds and even more preferred 1-5 seconds, typically about 3 seconds, the current supply periods preferably being considerably shorter than the pauses.
5. Method according to any of the preceding claims, characterised in that a current is applied during the current supply periods, which current is strong enough in order for each cell in the accumulator to reach a voltage of at least 2.5 V during the current supply periods.
6. Method according to any of the preceding claims, characterised in that said current level during said current supply periods amounts to at least 110 A,

preferably at least 200 A and even more preferred at least 250 A, but 1000 A at the most.

- 5 7. Method according to any of claims 1-5, characterised in that a current level during said current supply periods is 150 A at the most, preferably 110 A at the most.
- 10 8. Method according to any of the preceding claims, characterised in that the treatment process is performed in a number of cycles, preferably 5-30 and even more preferred 5-20 cycles, each cycle consisting of a regeneration part of 2-8 hours, preferably 2-6 hours and most preferred about 6 hours, and a charge part, preferably using standard charging, i.e. using a continuous current supply, during 0.5-2 hours, preferably about 1 hour.
- 15 9. Method according to any of the preceding claims, characterised in that said registering of process data and said controlling, is continuously performed during the entire or essentially the entire treatment process.
- 20 10. Method according to any of claims 1-8, characterised in that said registering of process data is performed during a predetermined time period of the entire treatment period, preferably during start up of the treatment.
- 25 11. Method according to any of the preceding claims, characterised in that said registering of process data and controlling based on this process data, is individually performed for all or essentially all cells in the accumulator.
- 30 12. Method according to any of the preceding claims, characterised in that the total current running to the accumulator during the current supply periods is registered, preferably by surveying of a mean value for said process data for a small number of current supply periods, optimal control, and thereby optimal treatment, thereafter being ensured when the mean value of the succeeding current supply periods, remains in the main constant.
- 35 13. Method according to any of the preceding claims, characterised in that general data, for each individual accumulator, is used for the controlling of the treatment process, which general data preferably is chosen from the group consisting of name of the customer, date, accumulator manufacturer, type number

for the accumulator, type values for the accumulator, year of manufacture, time of the first operational use of the accumulator, time between previously performed treatments, type of device in which the accumulator is used, and which general data preferably is registered automatically at start up of the treatment process.

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14. Method according to claim 13, characterised in that older general data and process data too, for other accumulators and/or for previous treatments of the specific accumulator, are used for the controlling of the treatment process.

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15. Method according to claim 14, characterised in that access to said older general data and older process data is ensured by connection to a network having a common database for these data for different devices for the treatment of accumulators.

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16. Method according to claim 15, characterised in that said network also is arranged to be used for the surveillance of the treatment process and/or for the upgrading of software for the treatment process.

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17. Device for treatment of accumulators having at least one cell, preferably lead batteries, which device comprises a transformer having a primary coil adapted to be connected to the electricity supply network, a secondary coil, a rectifier connected to the secondary coil, a positive and a negative cable clip, adapted to be connected to an accumulator which is to be treated, and an automatic actuator connected to the primary coil for intermittent connecting and disconnecting of the electricity supply network with short current supply periods interrupted by current free pauses, characterised in that said device constitutes a device for a regeneration process, the device being arranged to conduct said current supply periods with a length of between 0.01 and 0.5 seconds, a current level during said current supply periods being arranged to amount to between 80 and 1000 A, and to conduct said pauses with a length of 1-20 seconds, and in that the device also comprises means for registering/measuring of process data, at least in one cell of the accumulator, and means for controlling the treatment process based on this process data.

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18. Device according to claim 17, characterised in that sensors for registering/measuring a conductivity in an electrolyte in the cell, constitutes said means

for registering/measuring process data, and/or sensors for registering/measuring a temperature in the electrolyte in the cell, said registering/measuring preferably being arranged to be performed by opening of the accumulator and applying said sensors.

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19. Device according to any of claims 17-18, characterised in that said means for registering/measuring process data are arranged to individually register/measure process data in all or essentially all cells of the accumulator, the treatment process preferably being arranged to be individually controlled in these cells, based on the process data for each cell.

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20. Device according to any of claims 17-19, characterised in that said means for controlling the treatment process comprises a control unit, preferably a microcomputer, and means for dynamically, during the treatment process, altering the length of said current supply periods to between 0.01 and 0.5 seconds, preferably at least 0.1 seconds, even more preferred at least 0.15 seconds and 0.4 seconds at the most, preferably 0.25 seconds at the most, a length of said pauses, which may be between 1-20 seconds, preferably 1-10 seconds and even more preferred 1-5 seconds, typically about 3 seconds, the current supply periods preferably being considerably shorter than the pauses, and optionally, the current level used.

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21. Device according to any of claims 17-20, characterised in that the device is arranged to yield a current during said current supply periods, which current is strong enough in order for each cell in the accumulator to be brought to reach a voltage of at least 2.5 V during the current supply periods.

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22. Device according to any of claims 17-21, characterised in that the current level during said current supply periods is at least 110 A, preferably at least 200 A and even more preferred at least 250 A, but 1000 A at the most.

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23. Device according to any of claims 17-21, characterised in that the current level during said current supply periods is 150 A at the most, preferably 110 A at the most.

24. Device according to any of claims 17-23, characterised in means for the, preferably automatic, registering/feeding in of general data, for each indi-

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vidual accumulator, which general data preferably is chosen from the group consisting of name of the customer, date, accumulator manufacturer, type number for the accumulator, type values for the accumulator, year of manufacture, time of the first operational use of the accumulator, time between previously performed treatments, type of device in which the accumulator is used.

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25. Device according to claim 24, characterised in that said device comprises means for connecting it to a database, preferably via a network, for use of older general data and process data for previous treatment processes, for other accumulators and/or for previous treatments of the specific accumulator, in the controlling of the treatment process.

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26. Device according to claim 25, characterised in that said network also is arranged to be used for the surveillance of the treatment process and/or for the upgrading of software for the treatment process.

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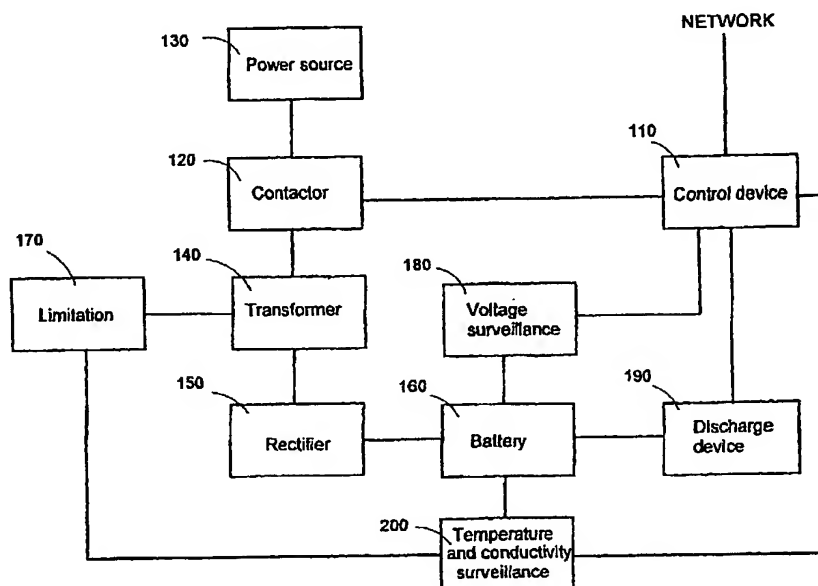
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(54) Title: **METHOD AND DEVICE FOR BATTERIES**



(57) Abstract: Method for treatment, in the form of regeneration, of accumulators having at least one cell, preferably lead batteries, in which a varying direct voltage from a charging unit is applied in intermittent current supply periods, which are interrupted by current free pauses, the direct voltage being sufficient to generate gas in the accumulator. During the treatment process, process data is registered, for at least one cell in the accumulator, which process data is used in order to control the treatment process.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

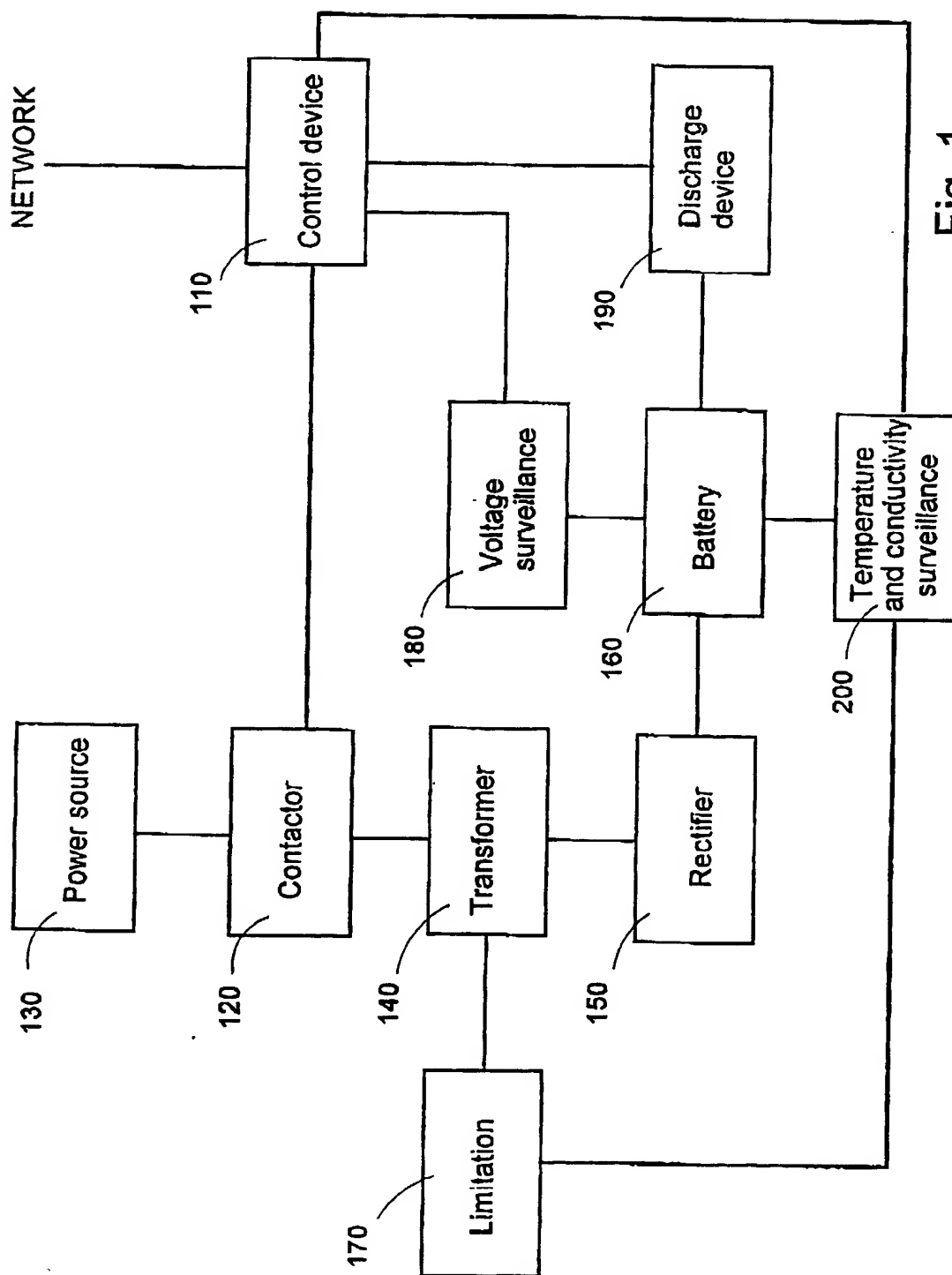


Fig. 1

RULE 63 (37 C.F.R. 1.63)
DECLARATION AND POWER OF ATTORNEY FOR UTILITY OR DESIGN PATENT APPLICATION IN THE
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[X] Declaration Submitted with Initial Filing or [] Declaration Submitted after Initial Filing (surcharge 37 CFR 1.16 (e) required). As a below named inventor, I hereby declare that my residence, post office address and citizenship are as stated below next to my name, and I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the INVENTION ENTITLED "METHOD AND DEVICE FOR BATTERIES", the specification of which is:

[X] attached hereto as Attorney Docket No. 627-P1446, OR
 [] was filed on (MM/DD/YYYY) _____. As United States Application Number (Attorney Docket No. _____) or
 U.S. National Phase of PCT International Application No. PCT/SE00/01049.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above. I acknowledge the duty to disclose all information known to me to be material to patentability as defined in 37 C.F.R. 1.56 including for continuation-in-part application, material information which becomes available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a) -(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international Application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or any PCT international application having a filing date before that of the application on which priority is claimed.

<u>PRIOR FOREIGN APPLICATION(S)</u>			<u>Priority Claimed</u>		<u>Certified Copy Attached</u>	
<u>Number</u>	<u>Country</u>	<u>Foreign Filing Date</u> (MM/DD/YYYY)	<u>Yes</u>	<u>No</u>	<u>Yes</u>	<u>No</u>
SE 9902286-5	SWEDEN	06/15/1999	X			X

I hereby claim the benefit under 35 U.S.C. 119(e) of any United States provisional Application(s) listed below.

PRIOR U.S. PROVISIONAL, NONPROVISIONAL AND/OR PCT APPLICATION(S)

<u>Application No. (series code/serial no.)</u>	<u>Filing Date</u> (MM/DD/YYYY)	<u>Status</u> <u>pending, abandoned, patented</u>	<u>Priority Claimed</u>	
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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

I hereby appoint the registered practitioners at **Manelli, Denison & Selter, PLLC**, represented by **Customer No.: 20736** to prosecute this application and transact all business in the U.S. Patent and Trademark Office in connection therewith. Direct all correspondence to **Customer No. 20736**.

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